PATENT SPECIFICATION

DRAWINGS ATTACHED

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1,042,553

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COMPLETE SPECIFICATION

Improvements in or relating to Speed Limiting Apparatus for Lifts and Hoisting Gears

We, INVENTIO AKTIENGESELLSCHAFT, of Hergiswil, Switzerland, a joint stock company incorporated under the laws of Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to speed limiting apparatus for lifts and hoisting gears.

Personnel lifts and freight hoisting apparatus accessible to personnel are provided with a check device, which, upon the normal travelling speed being exceeded by a certain value, at least during the downward run, is brought into action by a speed limiter usually mounted at the upper end of the lift shaft. The operation of the check device is effected by means of a cable driving the speed limiter, in that the cable pulley of the speed limiter, and therewith the cable passing round it, is braked. Preferably the operation of the check device is also effected by the speed limiter upon a predetermined acceleration being exceeded.

The present invention more specifically relates to a speed limiter for lifts and hoisting apparatus wherein, upon the normal travelling speed being exceeded, centrifugal weights which are rotated by the cable pulley are pressed against a stationary braking drum and thereby retard the cable pulley and the cable.

In a previously suggested speed limiter of this type two centrifugal weights are provided, for example of crescent shape, each of these weights being mounted, with one end thereof as a pivot, upon a disc keyed to the cable pulley shaft. The other end of each of the centrifugal weights has a jointed connection through a link to a bush freely mounted upon the cable pulley shaft. A spiral spring engaging between the shaft and the bush tends to rotate the bush in such a sense that the centrifugal weights come to bear upon studs arranged upon the disc inside the curve of the crescent shaped weights. The spiral spring is so designed that, under normal speed conditions, the centrifugal weights are held in this supported condition in opposition to the centrifugal force acting upon them. The centrifugal weight arrangement is located in a stationary braking drum. Upon the normal speed or the predetermined acceleration of travel being exceeded, the centrifugal force gradually causes a rotation of the centrifugal weights outwardly so that these come to bear on the inner side of the braking drum and the centrifugal weight arrangement is retarded.

The centrifugal force increases in fact quadratically with respect to the speed of rotation, but this force must however overcome the force of the spring, which acts in opposition to the centrifugal force and the magnitude of which increases linearly with the length of the path traversed. For carrying out a switching movement it is therefore necessary to have a relatively large increase in the speed of travel, which, however, only takes place slowly. In the described and similar types of known speed limiters, the switching path from the moment when the centrifugal weights leave the supporting position up to the braking position is traversed relatively slowly so that if the lift cage exceeds the normal speed of travel, it will still pass through a comparatively large distance until the time of operation of the check device, especially in the case of modern lifts having a high nominal speed. The increase in speed which takes place in

[*Price*

this time again makes necessary a still greater second order increase in braking power.

Furthermore such speed limiters exhibit the disadvantage that they do not lock themselves in their operative position, but upon further decrease in the travelling speed automatically return to the initial position.

For the purpose of obtaining a rapid operation it has been proposed to use, in association with a speed limiter fitted with a bolt cage in place of a braking drum, a centrifugal weight arrangement employing centrifugal weights in the form of bolts which are radially displaceable in the bores of carrier arms. The centrifugal bolts are arranged to be under the influence of spring forces which tend to force these bolts radially outward. The centrifugal bolts are, however, held in a starting position by a locking device consisting of a spring loaded ball which engages in a groove provided in the centrifugal bolts. The centrifugal bolts leave the initial position as soon as the radially outward directed spring force and centrifugal force overcome the frictional forces produced by the locking device. Upon leaving the starting position, the frictional force becomes so small as to be disregarded so that the centrifugal bolt moves radially outward at great speed. It then comes to bear upon one of the cage bolts and thus effect the retardation of the cable operating the check device.

This centrifugal weight arrangement is, however, liable to faults. Since it operates in dependence upon frictional forces, there exists the danger that these forces may become excessively high, for example due to oxidation. Furthermore such speed limiters have the disadvantage that they do not respond to excess acceleration.

It is an object of the present invention to provide a speed limiter for lifts and hoists, which has a very short switching time and, whilst still avoiding the use of a locking device and the disadvantages associated therewith, will respond to excessive acceleration and after being operated will not return automatically into the initial position.

The invention consists in a speed limiting device for lifts and hoists, which comprises at least one centrifugal body pivotally mounted upon a rotating carrier at a point displaced from the axis of rotation of the carrier, said centrifugal body being retained, during normal speed of travel, by means of a spring force acting in opposition to the centrifugal force, in a preset position determined by a stop arranged upon the carrier, such centrifugal body, upon the normal speed of travel being exceeded, traversing a definite pivoting angle to cause braking of the carrier by engagement with a stationary portion of the casing structure, wherein springs producing the spring force, together with the centrifugal bodies respectively movable about pivoting axes from an assembly which can be tilted within the range of operative pivoting movement of the centrifugal body in such a manner that when the centrifugal body leaves its preset position, the spring exerts thereon a torque which decreases as a function of the pivoting angle moved through by the centrifugal body and, when a point of zero torque is passed, again increases in the opposite sense. The pivoted axis of the centrifugal body may be arranged upon the middle circle of three circles of different diameters concentric with the rotation axis of the carrier, whilst one end point of a tension spring is connected upon the largest of the circles to the centrifugal body and the other end point of the tension spring is connected upon the smallest diameter circle to the carrier in such a manner that when the centrifugal body traverses its pivoting angle, the line of action of the tension spring progresses from the one to the other side of the pivoting axis of the centrifugal body. One end point of one tension spring and one end of a link may be connected to a ring freely rotatable about the rotation axis of the carrier, whilst the pivoting axis of the centrifugal body is arranged upon the middle circle of three concentric circles of different diameters described about the ring, whilst the other end point of the tension spring is connected to the centrifugal body upon the largest diameter circle, and the other end point of the link is connected to the centrifugal body upon the smallest diameter circle in such a manner that when the centrifugal body traverses its pivoting angle, the line of action of the tension spring, whilst remaining at the same side of the pivot axis of the centrifugal body, progresses from the one to the other side of a straight line passing through the end points of the link. Upon the concentric circles there may be arranged a second centrifugal body with accessory parts arranged in the same manner as the first one and displaced through 180° with respect thereto and forming with the first centrifugal body a pair. Upon the concentric circles there may be arranged a second pair of centrifugal bodies which are a mirror image of the first pair and are displaced through 90° with respect thereto. The centrifugal bodies may be designed as locking cams.

In order to make the invention clearly understood, reference will now be made to the accompanying drawings, which are given by way of example and in which:—

Fig. 1 shows an elevation, and

Fig. 2 shows a section along the line A—A of a first embodiment of a speed limiter;

Fig. 3 shows a graphic representation of the torques;

Fig. 4 shows an elevation, and

Fig. 5 shows a section along the line B—B of a second embodiment of a speed limiter.

In Figs. 1 and 2, the frame part of the apparatus is represented by 1, this comprising a pedestal 1.1, a bearing hub 1.2, and a brake drum 1.3. 2 is a cable pulley about which is wrapped a braking cable 3. The cable pulley 2 is keyed to a shaft 4, which is rotatably supported in the bearing hub 1.2 by means of ball bearings 5. Upon the cable pulley 2 there are mounted two pairs of centrifugal bodies 6, 7 and 8, 9 located in the hollow space of the brake drum 1.3, designed as locking cams rotatable about the pivoting axes 6.1, 7.1 and 8.1, 9.1 respectively and uniformly spaced upon a circle K_1 concentric with the shaft 4. The cable pulley 2 thus assumes the function of a carrier for rotating the centrifugal bodies 6.7, 8 and 9 about the rotation axis R_1.

Each centrifugal body is provided with a stop screw 6.2 and 7.2, and 8.2 and 9.2 respectively. 10 and 11 are two stops secured to the cable pulley. 12, 13, 14 and 15 are tension springs, which are adjustably secured at one end to each of the centrifugal bodies 6, 7 and 8, 9 by means of retaining members 6.3, 7.3 and 8.3, 9.3 respectively and have their other ends suspended in eyes 16.1, 17.1 and 18.1, 19.1 respectively of pins 16, 17, 18 and 19 screwed into the shaft 4. The retaining members 6.3, 7.3 and 8.3, 9.3 are arranged upon a circle K_2 concentric with the circle K_1 and the eyes 16.1, 17.1, 18.1, 19.1 are arranged upon a circle K_3 likewise concentric with the circle K_1.

12.1, 13.1, 14.1, 15.1 represent the lines of action of the tension springs 12, 13, 14 and 15. The entire apparatus is so devised that in the rest position shown in the drawing the tension springs 12 and 13 respectively tend to rotate the respective centrifugal weights 6 and 7 in the clockwise direction about the pivoting axes 6.1 and 7.1 whilst the tension springs 14 and 15 respectively tend to rotate the centrifugal weights 8 and 9 respectively in the counterclockwise direction about the pivoting axes 8.1 and 9.1 and that, when the centrifugal bodies 6, 7, 8 and 9 perform the pivoting movement through their switching angles, the lines of action 12.1, 13.1, 14.1, 15.1 of the respective tension springs 12, 13, 14 and 15 progress from the one to the other side of the pivot axes 6.1, 7.1, 8.1, 9.1 of the respective centrifugal bodies 6, 7, 8 and 9. The diametrically oppositely situated centrifugal bodies of a pair 6, 7 and 8, 9 respectively are freely joined together by links 20, 21 and 22, 23 respectively and a respective ring 24 and 25 freely movable upon the shaft 4.

The limiter cable 3 is connected to devices which are known *per se* and are therefore not shown in the drawing. This cable is formed as an endless loop tensioned in the pit of the shaft by means of gravity-loaded cable deflecting pulley and is secured to the release lever of a check device arranged at the lift cage. The limiter cable 3 thus drives the speed limiter at an angular velocity proportional to the travelling speed of the lift. Upon the centrifugal bodies 6, 7, 8, 9 there is effective a centrifugal force which tends to rotate these bodies outwardly. The tension springs 12, 13, 14, 15 are however so designed that, up to a definite speed of travel, namely the release speed, the centrifugal bodies 6, 7, 8 and 9 bear against the stops 10 and 11. The influence of the weight of the centrifugal bodies is compensated by the paired arrangement indicated in the drawing because the centrifugal bodies 6, 7, and 8, 9 respectively are connected together through the links 20, 21 and 22, 23 respectively and the rings 24 and 25.

For explaining the mode of operation of the speed limiter upon the release speed being exceeded it will be sufficient to consider one of the centrifugal bodies, for example the centrifugal body 6, because the behaviour of the others is analogous thereto whilst, if the influence of the weight is not taken into consideration, the link 20 can also be omitted. Here it will be assumed that the speed limiter rotates in the clockwise direction, which corresponds, for example, to the downward travel of the lift. After the release speed is exceeded, the centrifugal body 6 is lifted away from the stop 10. Thereby the distance between the line of action 12.1 of the spring 12 and the pivot axis 6.1 diminishes so that the torque which was exercised in the clockwise direction by the practically constant spring force rapidly diminishes. In the indicated arrangement of the centrifugal body 6, the torque exercised in the counterclockwise direction by the centrifugal force reduces only slightly even in the most unfavourable case, so that the result of the spring force and the centrifugal force is automatically increasing torque in the counterclockwise sense, which, without the necessity of any further increase in the speed of travel, causes a rotation of the centrifugal body in the counterclockwise direction.

The torque produced by the spring 12 diminishes during the pivoting of the centrifugal body 6 and becomes zero when the line of action of the spring 12.1 passes through the pivoting axis 6.1. Following this the spring torque increases with the opposite sign so that now only torques acting in the counter-clockwise sense are effective. As soon as the centrifugal body 6 comes into contact with the brake drum 1.3 there is produced by the friction an

additional torque acting in the counter-clockwise sense, which, on account of the wedging action of the centrifugal body 6 resulting from its design as a locking cam, increases rapidly whereby the cable pulley 2 is braked within the shortest time. The wedging action of the centrifugal bodies is dependent upon the direction of rotation so that the braking of the cable pulley 2 is effected during the downward run of the lift by the centrifugal bodies 6 and 7. The described speed limiter is designed for control of both directions of travel and therefore possesses a second pair of centrifugal bodies consisting of the centrifugal bodies 8 and 9, which retard the cable pulley 2 upon the normal speed of travel being exceeded in the upward direction.

By reason of the automatic increase in the torque acting in the counter-clockwise direction in the above described manner upon the release speed being exceeded, the pivoting angle of the centrifugal weight 6 is traversed very rapidly. The same procedure also follows when a predetermined acceleration of travel is exceeded, but in that case the acceleration force acting upon the centrifugal body 6 is then responsible for the operation. This acceleration force is dependent upon direction of rotation so that again during the downward run, i.e. upon rotation of the pulley in the clockwise direction, the centrifugal bodies 6 and 7 come into operation and during the upward run, i.e. when the pulley is rotating in the counter-clockwise direction, the centrifugal bodies 8, 9 come into operation. After the release of the speed limiter has been effected, the centrifugal bodies remain in the braking condition which they have assumed and must be returned by hand into the initial position.

In the graphical representation of Fig. 3, the torques acting upon the centrifugal body 6 when the release speed of the speed limiter is exceeded are plotted as a functional of the angular position of the centrifugal body 6, in which case the assumption has been made that the speed of travel during the pivoting motion of the centrifugal body remains constant. Upon the ordinate 26 are plotted the magnitudes of the torques, these being plotted upwardly in the case of the counter-clockwise torques and downwardly in the case of the clockwise torques. Upon the abcissa 27 there are plotted the values of the pivoting angle of the centrifugal body 6. 28 is the curve representing the spring force, while 29 is the curve of the torque resulting from the centrifugal force. The curve 30 shows the course taken by the sum of these torques.

From the diagram it is evident that with increasing angle of pivoting the clockwise torque represented by the curve 28 falls continuously and at the angular position 31, which corresponds to the position in which the line of action 12.1 of the spring 12 passes through the pivoting axis 6.1, the curve passes through the zero value and the corresponding torque, now acting clockwise, continuously increases in the opposite direction up to the angular position 32 in which the centrifugal body 6 bears against the brake drum 13. The curve 29 is shown as a curve with a slight declination. According to curve 30 the resulting torque increases continuously in the counter-clockwise direction even when the speed of travel remains constant. If the speed of travel increases after the release point, which will mostly be the case in practice, then the curve 29 will be a rising curve and the curve 30 will therefore be still steeper.

The embodiment of Figs. 4 and 5 shows another form of the speed limiter in accordance with the invention.

This again comprises a frame portion 1 with a pedestal 1.1, a bearing hub 1.2 and a brake drum 1.3. In the bearing hub 1.2 a shaft 33 is rotatably supported by means of ball bearings 5, and a coupling disc 34 is keyed to the shaft. 35 is a coupling ring and 36 is the cable pulley round which passes the speed limiter cable 3. The cable pulley 3 is centered with a sliding fit upon the coupling disc 34 and, by means of the coupling ring 35, the screws 37, nuts 38 and disc spring 39, is resiliently pressed against the coupling disc, whilst for this purpose the seating surfaces of the cable pulley 36 are provided with clutch linings 36.1. Upon the coupling disc 34 there are mounted a pair of centrifugal bodies 40, 41 shaped as locking cams and located in the hollow of cavity of the brake drum 1.3, these bodies being oppositely located upon a circle K_{1_0}, concentric with the shaft 33 and movably mounted upon the pivot axes 40.1 and 41.1. The coupling disc 34 assumes the function of a carrier for rotating the centrifugal bodies 40, 41 about the rotation axis R_{1_0}. Each centrifugal body is provided with a stop screw 40.2 and 41.2, which cooperate with two respective stops 42, 43 fixed to the coupling disc 34. 44 and 45 are tension springs, adjustably secured at one end to a centrifugal body by the retaining members 40.3, 41.3 lie upon the largest ends of the springs are hooked into the pins 46.1 and 46.2 respectively of a ring 46 rotatably mounted upon the shaft 33, and these springs have the lines of action 44.1 and 45.1 respectively. 47 and 48 indicate links which are freely joined at one end to one of the centrifugal bodies 40, 41 by means of studs 40.4 and 41.4 and at the other end are freely joined by means of the pins 46.1 and 46.2 to the ring 46, and these links have

lines of action 47.1 and 48.1. The retaining members 40.3, 41.3 lie upon the largest of three circles K_{11}, K_{12}, K_{13} concentric with the circle K_{10}, whilst the studs 40.4, 41.4 lie upon the middle circle and the pins 46.1, 46.2 upon the smallest of the three circles. The arrangement of the tension springs 44, 45 and the links 47, 48 is so designed that the torque exercised by the tension springs 44 and 45 upon the centrifugal bodies 40 and 41 acts in the clockwise sense in the rest position indicated in the drawing and that, when the centrifugal bodies 40, 41 traverse their switching angle, the lines of action 44.1, 45.1 of the tension springs 44 and 45, whilst remaining at the same side of the pivot axes 40.1, 41.1 of the centrifugal bodies 40, 41, move from the one to the other side of the lines of action 47.1, 48.1 of the respective links 47, 48. The torque produced by the tension spring 44 or 45 is composed of a torque operating in the counter-clockwise direction and transmitted by means of the link 47 or 48 to the centrifugal body 40 or 41 and also a clockwise acting torque produced by the spring 44 or 45 acting through the retaining member 40.3 or 41.4 directly upon the centrifugal body 40 or 41. By the indicated arrangement, wherein the line of action 47.1 or 48.1 of the link 47 or 48 lies between the line of action 44.1 or 45.1 of the spring 44 or 45 and the pivoting axis 40.1 or 41.1, the effect is obtained that the torque in the clockwise sense is the greater. The ring 46 is externally adjustable for resetting, as described below, this being done by means of an adjusting stud 49 which is arranged in a bore 33.1 of the shaft 33. For this purpose the adjusting stud 49 is connected to the ring 46 by means of a pin 50 passed through slots 33.2 in the shaft.

The speed limiter of Figs. 4 and 5 is designed for only one direction of travel and in fact serves for controlling the downward direction of travel, in which the arrangement is driven in the clockwise direction. For explaining the mode of operation only one centrifugal body will again be considered, this being the centrifugal body 40. So long as the speed of travel of the lift does not exceed the release value, the counter-clockwise torque exerted upon the centrifugal body by the centrifugal force is smaller than the clockwise torque exerted by the spring force so that the centrifugal body 40 bears against the stop 42. As soon as the release speed is exceeded, the centrifugal body 40 lifts itself from the stop 42. Thereby the distance is reduced between the line of action 44.1 of the tension spring 44 and the pivot axis 40.1, whilst the distance between the line of action 47.1 of the link 47 and the pivot axis 40.1 becomes greater. From this there results a strong reduction of the clockwise torque exerted by the tension spring 44.

The result of the spring force and the centrifugal force is again an automatically increasing torque in the counter-clockwise sense. The torque resulting from the action of the tension spring 44 becomes zero during the pivoting of the centrifugal body 40 when the line of action of the spring 44.1 coincides with the line of action 47.1 of the link and, upon further pivoting of the centrifugal body 40, increases with the opposite sign so that now only torques of the counter-clockwise sense are effective. The curve of the torque acting upon the centrifugal body 40 as a function of its angle of pivoting is analogous to that represented in the diagram of Fig. 3, whilst the curve 28 corresponds to the sum of the torques caused by the spring force and the curve 24 of the torque resulting from the centrifugal force.

On account of the frictional effect and the wedging action of the centrifugal bodies 40, 41 which are designed as locking cams, the coupling disc is brought to rest in the minimum time upon operation of the speed limiter. After the operation of the check device, the lift cage covers a definite retardation distance during which the limiter cable 3 and the cable pulley 36 are taken with it. The pressure between the cable pulley 36 and the coupling disc 34 is adjusted by means of the screw 37 in such a manner that, upon a predetermned cable tension being exceeded, the cable pulley 36 slides over the coupling disc 34. In this way the speed limiter cable 3 is protected from overload.

The resetting of the centrifugal bodies from the braking position into the initial position is effected by rotating the adjusting stud 49, which operates directly upon the ring 46 and through the links 47 and 48 upon the centrifugal bodies 40, 41.

The invention is not limited to the practical examples illustrated herein but includes within its scope various other modifications. Thus, for example, a bolt cage can be used in place of a brake drum. Also the centrifugal bodies and the number of centrifugal bodies used may be different and may have a geometrical form different from that shown in the drawing. Moreover the brake drum, instead of being arranged stationary with respect to the other parts of the framework, may be rotatable within certain limits possibly for the purpose of operating a contact controlling the position of the speed limiter.

WHAT WE CLAIM IS:—

1. A speed limiting device for lifts and hoists, which comprises at least one centrifugal body pivotally mounted upon a rotating carrier at a point displaced from the

axis of rotation of the carrier, said centrifugal body being retained, during normal speed of travel, by means of a spring force acting in opposition to the centrifugal force, in a preset position determined by a stop arranged upon the carrier, such centrifugal body, upon the normal speed of travel being exceeded, traversing a definite pivoting angle to cause braking of the carrier by engagement with a stationary portion of the casing structure, wherein springs producing the spring force, together with the centrifugal bodies respectively movable about pivoting axes form an assembly which can be tilted within the range of operative pivoting movement of the centrifugal body in such a manner that when the centrifugal body leaves its preset position, the spring exerts thereon a torque which decreases as a function of the pivoting angle moved through by the centrifugal body and, when a point of zero torque is passed, again increases in the opposite sense.

2. A speed limiting device as claimed in claim 1, wherein the pivoting axis of the centrifugal body is arranged upon the middle circle of three circles of different diameters concentric with the rotation axis of the carrier, whilst one end point of a tension spring is connected upon the largest of the circles to the centrifugal body and the other end point of the tension spring is connected upon the smallest diameter circle to the carrier in such a manner that when the centrifugal body traverses its pivoting angle, the line of action of the tension spring progresses from the one to the other side of the pivoting axis of the centrifugal body.

3. A speed limiting device as claimed in claim 1, wherein one end point of one tension spring and one end of a link is connected to a ring freely rotatable about the rotation axis of the carrier, whilst the pivoting axis of the centrifugal body is arranged upon the middle circle of three concentric circles of different diameters described about the ring, whilst the other end point of the tension spring is connected to the centrifugal body upon the largest diameter circle, and the other end point of the link is connected to the centrifugal body upon the smallest diameter circle in such a manner that when the centrifugal body traverses its pivoting angle, the line of action of the tension spring, whilst remaining at the same side of the pivot axis of the centrifugal body, progresses from the one to the other side of a straight line passing through the end point of the link.

4. A speed limiting device as claimed in claim 2 or 3, wherein upon the concentric circles there is arranged a second centrifugal body with accessory parts arranged in the same manner as the first one and displaced through 180° with respect thereto and forming with the first centrifugal body a pair.

5. A speed limiting device as claimed in claim 4, wherein upon the concentric circles there are arranged a second pair of centrifugal bodies which are a mirror image of the first pair and are displaced through 90° with respect thereto.

6. A speed limiting device as claimed in any one of claims 1 to 5, wherein the or each centrifugal body is designed as a locking cam.

7. A speed limiting device for lifts and hoists, constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figs. 1, 2 and 3 of the accompanying drawings.

8. A speed limiting device for lifts and hoists, constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figs. 4 and 5 of the accompanying drawings.

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1042553 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

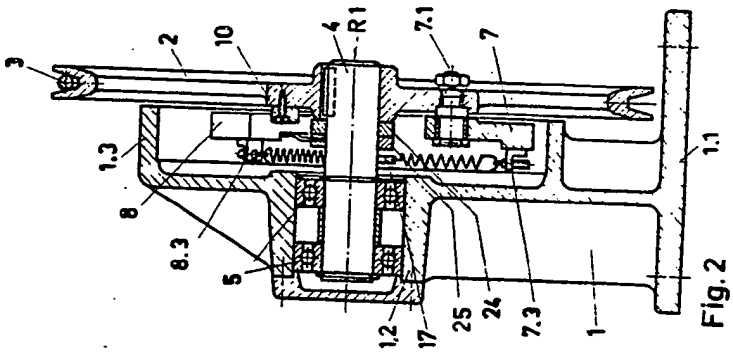

Fig.2

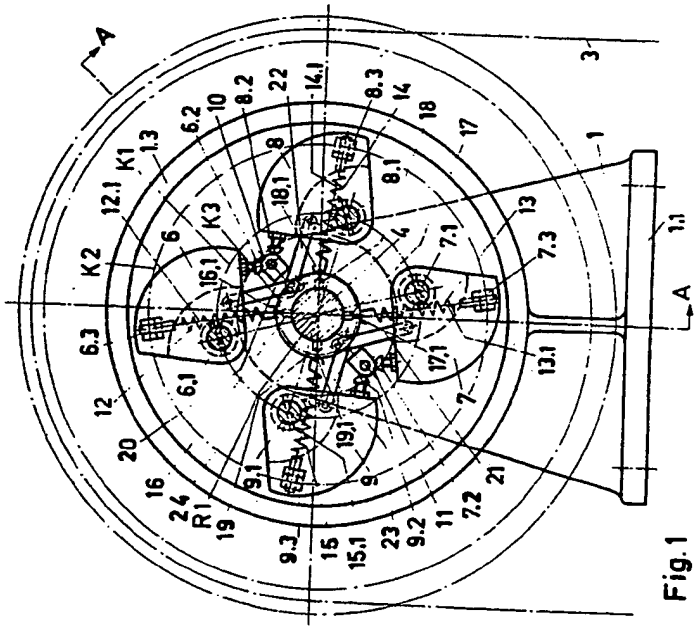

Fig.1

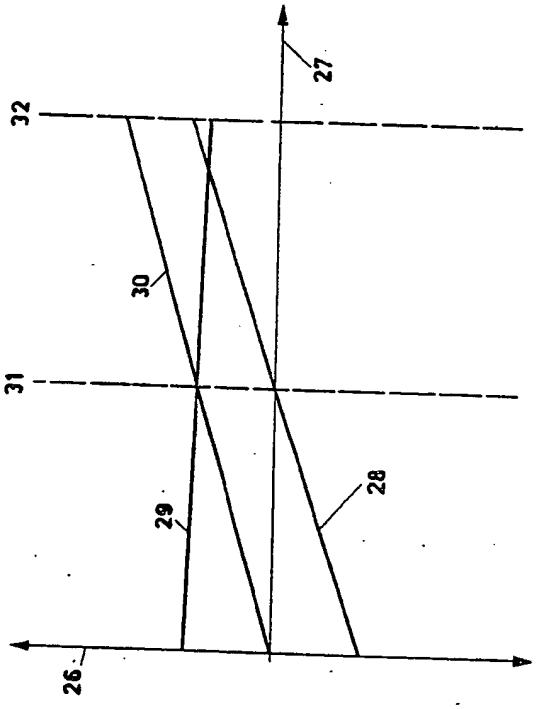

Fig. 3

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Sheets 2 & 3

Fig. 3

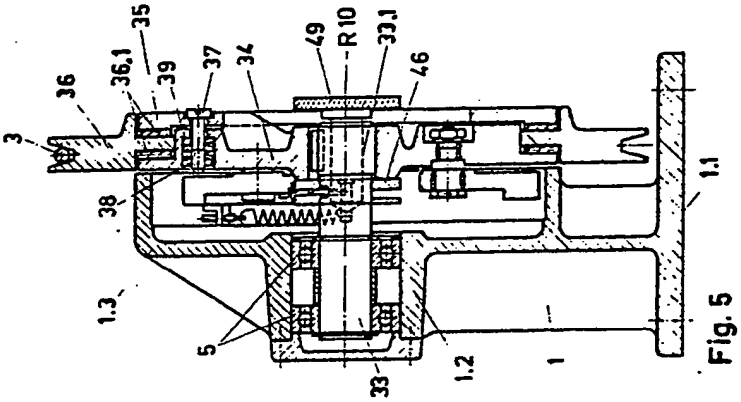

Fig. 5

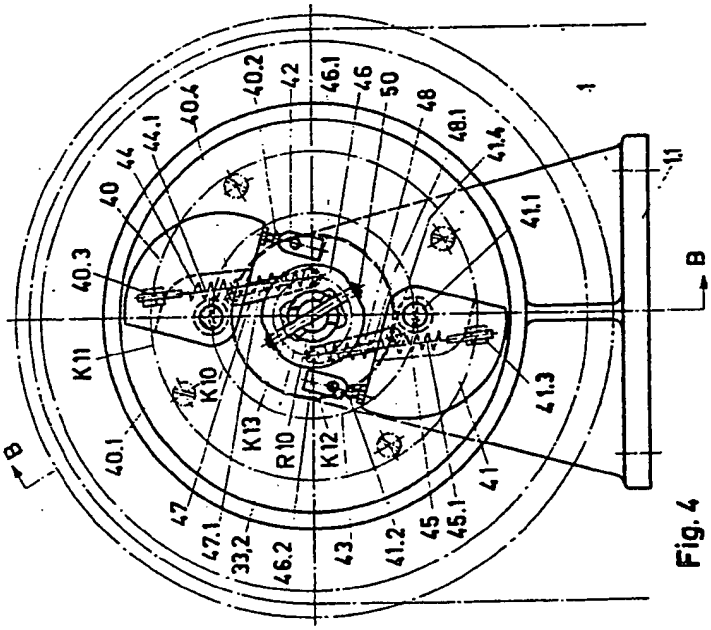

Fig. 4

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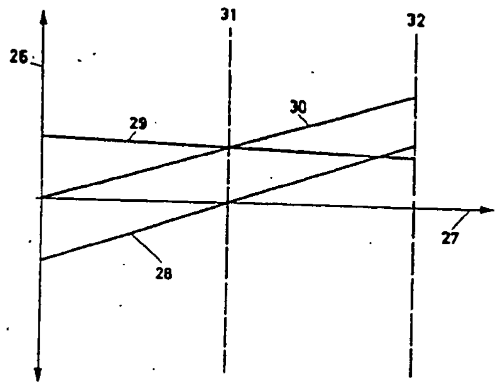

Fig. 3

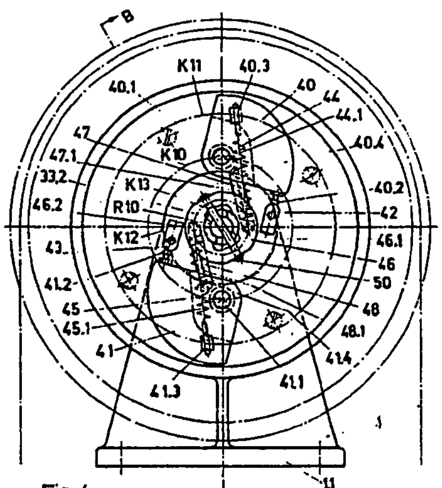

Fig. 4

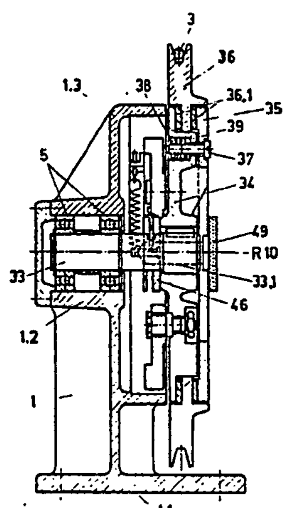

Fig. 5